gained by their larger brains? Why has there been this selection in all lines of animal descent of increased cerebral tissue?

I think we gain a key to the answer to this question by a consideration of the differences of cerebral quality between man and apes. Man is born with fewer ready-made tricks of the nerve centres—those performances of an inherited nervous mechanism so often called by the ill-defined term "instincts"—than are the monkeys or any other animal. Correlated with this absence of inherited ready-made mechanism, man has a greater capacity for developing *in the course of his individual growth* similar nervous mechanisms (similar to but not identical with those of "instinct") than any other animal. He has a greater capacity for "learning" and storing his *individual* experience, so as to take the place of the more *general* inherited brain-mechanisms of lower mammals. Obviously such brain-mechanisms as the individual thus develops (habits, judgments, &c.) are of greater value in the struggle for existence than are the less specially-fitted instinctive in-born mechanisms of a race, species or genus. The power of being educated—"educability" as we may term it—is what man possesses in excess as compared with the apes. I think we are justified in forming the hypothesis that it is this "educability" which is the correlative of the increased size of the cerebrum. If this hypothesis be correct—then we may conclude that in all classes of Vertebrata and even in many Invertebrata—there is and has been a continual tendency to substitute "educability" for mere inherited brain-mechanisms or instincts, and that this requires increased volume of cerebral substance. A mere spoonful of cerebral tissue is sufficient to carry abundant and highly efficient *instinctive* mechanisms from generation to generation; but for the more valuable capacity of elaborating *new* brain-mechanisms in the individual as the result of the individual's experience of surrounding conditions, a very much larger volume of cerebral tissue is needed.

Thus it seems probable that "educability" has increased in those Mammalia which have survived. The ancient forms with small brains though excellent "automata" had to give place, by natural selection in the struggle for existence, to the gradually increasing brains with their greater power of mental adaptation to the changing and varied conditions of life: until in man an organism has been developed which, though differing but little in bodily structure from the monkey, has an amount of cerebral tissue and a capacity for education which indicates an enormous period of gradual development during which, not the general structure, but the organ of "educability," the cerebrum, was almost solely the objective of selection.

Two lines of speculation and inquiry are strongly affected by the hypothesis thus sketched.

Firstly, as to the general laws of progressive development of bodily structure by the operation of natural selection—is it not probable that in various groups of animals, just as in the case of man among the Primates, the operation of natural selection on bodily structure (limbs, teeth, hair, horns, &c.) must have been checked, or even altogether suspended, by the transference of selection to the all-important organ of educability, the cerebrum or corresponding nerve-centres? Adaptation by means of the mental powers must take the place of adaptation of bodily structures. The educable animal leaves the ground and learns to climb trees in order to gain its food, whilst in another race the slower process of alteration of bodily form is evolving a long neck to reach the green twigs, or a ponderous strength of limb which can pull trees to the ground. Many similar cases will suggest themselves to the reader in which, even in lower animals, the capacity of learning by experience must (as it were) defeat and turn from its route the otherwise triumphant transformation of bodily structure.

Secondly, the question of the transmission of acquired characters is largely touched by these speculations. The character which we describe as "educability" can be transmitted, it is a congenital character. But the *results* of education can *not* be transmitted. In each generation they have to be acquired a-fresh, and with increased "educability" they are more readily acquired and a larger variety of them. On the other hand, the nerve-mechanisms of instincts are transmitted, and owe their inferiority as compared with the results of education to the very fact that they are *not* acquired by the individual in relation to his particular needs, but have arisen by selection of congenital variation in a long series of preceding generations.

To a large extent the two series of brain-mechanisms, the "instinctive" and the "individually acquired," are in opposition to one another. Congenital brain-mechanisms may prevent the education of the brain and the development of new mechanisms specially fitted to the special conditions of life. To the educable animal—the less there is of specialised mechanism transmitted by heredity, the better. The loss of instinct is what permits and necessitates the education of the receptive brain.

We are thus led to view that it is hardly possible for a theory to be further from the truth than that espoused by George H. Lewes and adopted by George Romanes, namely that instincts are due to "lapsed" intelligence. The fact is that there is no community between the mechanisms of instinct and the mechanisms of intelligence, and that the latter are later in the history of the development of the brain than the former, and can only develop in proportion as the former become feeble and defective.

These few lines—for the abruptness of which I apologise—will, I trust, serve to show the interesting nature of the speculations connected with the significance of the size of the cerebrum in various Mammalia and other animals. Some of the suggestions obtained from a consideration of the subject will, if carried out in detail, be found of first-rate importance in building up the science of comparative psychology.

ZONES IN THE CHALK.

THE philosophical observations on the genus *Micraster*, which were communicated by Dr. A. W. Rowe to the Geological Society in 1899, have been followed by the publication of his special researches on the zones of the white chalk on the coasts of Kent and Sussex. This second most valuable essay has been communicated to the Geologists' Association (*Proceedings*, vol. xvi. March 1900), who are to be congratulated on having such an addition to their published works. The paper follows along the lines so ably sketched out more than twenty years ago by Dr. Barrois; and Dr. Rowe, in nearly all cases, confirms the previous zonal distinctions and largely increases our knowledge. He shows how invaluable it is to collect stage by stage, and to pay the closest attention to the minute changes which the fossils, and particularly the Micrasters, undergo. The paper is essentially a zoological one, invaluable in indicating the succession of life, and as a contribution towards the genesis of species.

The ordinary subdivisions of lower, middle and upper chalk, which are important when we deal with purely geological problems, are not here dealt with; but the author, who apparently takes little interest in stratigraphy apart from fossils, admits that "we can generally recognise the zones from the appearance of the chalk alone, and that the fossils act as confirmatory evidence." This, indeed, is the experience of those who have worked at zones, and it is only by utilising properly all the evidence that satisfactory results can be obtained. Lithological evidence, often invaluable, is essentially local; the palæontological evidence, so ably and exhaustively dealt with by Dr. Rowe, is clear and uniform throughout the areas with which he deals. The fossils, as he remarks, "never fail us,"—that is to say, when you find them, their testimony is safe after the experience he has gained. He has been fortunate in having such an excellent series of sections to work at, and these are well depicted in two folding plates, drawn by Mr. C. Davies Sherborn. Inland, of course, the observer has only a pit-section or road-cutting here and there to act as a guide to the zonal divisions, but no doubt with the aid of the clear descriptions given by Dr. Rowe, and of the ascertained thicknesses of the several zones, it might be possible and even desirable to trace inland their approximate boundaries, if any useful purpose were thereby gained. In any case, Dr. Rowe's work will be appreciated alike by field-geologists and palæontologists. Prof. J. W. Gregory describes a new Echinoderm, and Dr. F. L. Kitchin describes a new species of *Terebratulina* from the chalk.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Mr. R. H. Yapp has been appointed assistant curator of the Herbarium under Prof. Marshall Ward.

Prof. Clifford Allbutt was on April 23 appointed physician to Addenbrooke's Hospital, in accordance with the recent agreement between the University and the governors.

Dr. Adami and Mr. de Soyres have been appointed delegates

to represent the University at the approaching Centennial of the University of New Brunswick.

The honorary degree of D.Sc. is to be conferred on Mr. Charles Hose, of Sarawak, to-day (April 26).

AT the spring graduation ceremony of Edinburgh University, the honorary degree of LL.D. was conferred upon Miss E. O. Ormerod, Dr. C. D. F. Phillips, and (*in absentia*) Dr. A. Stuart, professor of physiology in the University of Sydney.

IT is hoped (says the *Athenæum*) that the Prince of Wales will preside at the next Presentation ceremony of London University, which will be held in the new home of the University at South Kensington on May 9.

THE governors of the Goldsmiths' Company Technical and Recreative Institute, New Cross, again report a decline in the number of students, owing to the establishment of free evening continuation classes close to the Institute by the London School Board. It will be remembered that the extension of the work of the School Board to technical education has been called into question, and that the official auditor has disallowed items in the Board's accounts referring to such expenditure. The School Board has appealed against his decision, and the whole matter will shortly be argued in the Queen's Bench Division. The engineering department of the Goldsmiths' Institute shows an increase of members, in spite of the competition of free continuation classes. It is satisfactory to notice that the governors are taking steps to encourage students to undertake systematic courses of study, extending over three or more years, and propose to periodically test the efficiency of such courses by appointing independent examiners in grouped subjects, and to award special certificates for such examinations. Mr. J. Carrington having given 100 guineas towards the encouragement of systematic study, a portion of that sum will, during the current year, be devoted to prizes in connection with these special courses. The governors report that the quality of the work done in the advanced classes in chemistry is excellent, and some useful research work is being carried on by the students.

THE annual income of the Technical Education Committee of the Derbyshire County Council is at present about 11,000*l.*, exclusive of Science and Art Department's grants. This income is used to supplement local effort, and not to supersede it. Promising students of elementary schools in the county are assisted to proceed to secondary schools, and really able students of secondary schools are enabled to proceed to University or Technical Colleges, or Universities. In addition to awarding these scholarships the Council assists the development of the work of secondary schools, by means of building and equipment grants, supply of apparatus, &c. Agricultural experiments are carried on in connection with the Agricultural Department of the Nottingham University College, and the Midland Dairy Institute, Kingston, Notts. All the work of these institutions is placed under the inspection of the Board of Agriculture, which aids the work by a grant of 700*l.* a year. An experiment commenced in 1897 at Egginton for the purpose of demonstrating the influence on the quantity and quality of the herbage of permanent grass land by the use of different kinds of natural and artificial fertilisers has been continued. Each year the grass upon the different plots is cut and weighed, and the proportions of the various grasses and plants constituting the herbage is estimated. A member of the University College staff experienced in such work superintends the laying out of the plots, the sowing of the manures, and the cutting and weighing of the grass. The area under experiment is two and three-quarter acres, and the size of the plots one-eighth of an acre. The results of the experiment have been published for use by the agriculturists of the counties which promoted it.

THE report of the Advisory Committee appointed to inquire into the best manner of providing for scientific and commercial training respectively in connection with the new University of Birmingham has just been issued. It will be remembered that Mr. Andrew Carnegie and an anonymous donor each promised a gift of 50,000*l.* towards the establishment of these two departments. The committee have made inquiries as to facilities for the teaching of science in its application to industries, and they report that, in their opinion, no such teaching, complete as they contemplate it, and as it must be if it is to be successful, exists in any college in Great Britain. In making their recommendations, the committee have had in view the object of the teaching of science in its application to industry, coupled with such technical instruction in handicrafts as will enable the students to complete their course in the University itself. It is proposed that the facilities already provided in Mason University College should be supplemented by chairs of mining, metallurgy, engineering, and applied chemistry. The scheme submitted contemplates the introduction of a complete equipment for the treatment of metals by heat and a small plant for treatment by electricity, as well as the necessary outfit for testing metals. Shops would be provided for manual training, and it is recommended that the machines used should be of the best and most modern type of English, American, and foreign manufacture. The committee further recommend the acquisition of 25 acres of land in the outskirts of Birmingham on which to build the University, their estimate of the total cost being 155,000*l.*

SCIENTIFIC SERIALS.

American Journal of Science, April.—Skull, pelvis, and probable relationship of the huge turtles of the genus Archelon from the Fort Pierre Cretaceous of South Dakota, by G. R. Wieland. The marine turtles of the Fort Pierre Cretaceous of South Dakota not only represent the most gigantic species known, but also are of much importance as including undoubted descendants of Protostega from the underlying Niobrara Cretaceous, in common with which they may be regarded as ancient relatives of Dermochelys.—Application of the radio-micrometer to the measurement of short electric waves, by G. W. Pierce. A long loop of fine copper wire is suspended by a quartz fibre in a strong magnetic field. The lower ends are twisted together for some distance down, and carry at the bottom a mica vane on which is mounted a small resonator consisting of two vertical copper cylinders, joined by a constantan and a manganine wire which cross in the centre between the cylinders, and are attached to the ends of the copper wire. The impact of electric waves produces surgings between the two cylinders, which heat the junction and produce a thermo-electric current in the copper loop. The latter turns in the magnetic field, and thus indicates the waves. The author confirms Righi's observations of the different transparency of wood along and across the grain.—A large slab of Uintacrinus from Kansas, by C. E. Beecher. This paper contains photographs of a slab of limestone preserving on its surface a number of fine specimens of *Uintacrinus socialis*, Grinnell. It has 27 square feet of surface, and contains 220 crinoids.—Granodiorite and other intermediate rocks, by W. Lindgren. Granodiorite, a member of the great family of rocks with predominating soda-lime felspars, is distinguished by a granular texture, greyish colour, and a mineral composition of quartz, oligoclase or andesine, orthoclase or microcline, hornblende or biotite. The family represents an important and widespread type of rocks, especially common along the Pacific slopes of the Cordilleran ranges.—Two new American meteorites, by H. L. Preston. Describes the Luis Lopez siderite, characterised by the length of its bands of kamacite, and the Central Missouri meteorite, which is distinguished by the absence of etching figures, its beautiful pitting and prominent ridges of a lustrous dark steel-grey colour resembling graphite, and containing small quantities of carbon.

Annalen der Physik, No. 3.—Wave current generators, by C. Heinke. The author discusses variable currents from two different aspects. Some are generated as such, whereas others are generated by continuous currents broken up into variable currents by mechanical, liquid, or gaseous gaps in the circuit. The latter require a certain "saturation current" which is independent of the E.M.F.—Absorption of light in electrically-glowing gases, by M. Cantor. Kirchhoff's law does not hold for electrically glowing gases, though it may hold for flames. The author sent a strong beam of light through a vacuum tube from end to end and back, and compared its intensity with a beam passing through the open air. The beam of light suffered no absorption by the glowing gas. This result could only be made to agree with Kirchhoff's law of radiation by supposing the gas to possess an extremely high temperature. This, as we know, it does not possess. Hence we have a case of emission